STUDIES CONCERNING CHEMICAL FEATURES OF SOME INDUSTRIAL RESIDUES TO BE USED AS FERTILIZING RESOURCES

STUDII ASUPRA ÎNSUŞIRILOR CHIMICE ALE UNOR DESEURI INDUSTRIALE ÎN SCOPUL UTILIZĂRII ACESTORA CA RESURSE FERTILIZANTE

Adina BERBECEA, Isidora RADULOV, Alina LATO, F. SALA

Agricultural and Veterinary University of the Banat, Timişoara, Romania
Corresponding author: Adina Berbecea, e-mail:adinaberbecea@yahoo.com

Abstract *This paper represent an analyse of some industrial residues in purpose to be used as alternative fertilizing resources, in context of energy and raw material crises in inorganic fertilizers industry. We present the main ways in removing these kinds of residues and determine its chemical features.*

Rezumat *Această lucrare prezintă o analiză a unor deşeuri industriale în scopul utilizării lor ca resurse fertilizante, în contextul crizei de energie şi materie primă din industria îngrăşămintelor chimice.*

Key words: *sewage sludge, chemical features, fertilizing resource*
Cuvinte cheie*: nămol orăşenesc, caracteristici chimice, resurse fertilizante*

INTRODUCTION

Industrial society must learn that Earth had limited capacities of giving resources and absorbing industrial residues.

Between economic raising rate and residues, volume there is a direct bond, which intensifies the conflict between technosphere and ecosphere.

The intense industrial activities from last decades was followed by pollution, because industrial activity has consequence uncontrolled losses of materials in solid, liquid or gaseous form.

Under increasing assault by environmental groups for dumping waste into landfills, oceans rivers and lakes, or burning it in incinerators, corporation and local authorities, seems to have agreed upon a anew solution: they rename the waste as fertilizer or dust suppressant and spread it on farmers fields and country roads. The code word for this practice is “beneficial use”. While it may be an environmentally sound example of recycling, in many cases its relocating pathogens rather than disposing of them.

MATERIAL AND METHOD

Most wastewater treatment processes produce a sludge, which has to be disposed of. Conventional secondary sewage treatment plants typically generate a primary sludge in the primary sedimentation stage of treatment, and a secondary, biological sludge in final sedimentation after the biological process. The characteristics of secondary sludge vary with the type of biological process, and often it is mixed with primary sludge before treatment and disposal. Approximately one half of the costs of operating secondary sewage treatment plants in Europe can be associated with sludge treatment and disposal. Land application of raw or treated sewage sludge can reduce significantly the sludge disposal cost component of sewage

treatment, as well as providing a large part of the nitrogen and phosphorus requirements of many crops.

Very rarely do urban sewage systems transport only domestic sewage to treatment plants; industrial effluents and storm-water runoff from roads and other paved areas are frequently discharged. Thus, sewage contain in addition with organic waste materials, traces of many pollutants used in our modern society. Some of these substances can be phytotoxic and toxic for human and animals so it is necessary to control the concentration in the soil and the rate of application to the soil of potentially toxic elements.

Large amounts of sewage sludge are generated annually in each developed or developing country.

Table 1

Annually amounts of sewage sludge in some developed countries

Country	**Amounts (mil. tons dry solids / year)**
Austria	320
Belgium	75
France	700
Germany	2500
Greece	15
Ireland	24
United Kingdom	1107
United States	6900

In Table 2 are presented the main disposal methods and percentage of each.

Table 2

Disposal methods (%) of sewage sludge

Country	**Disposal method (%)**			
	Application to land	**Land filling**	**Incineration**	**Other**
Austria	13	56	31	0
Belgium	31	56	9	4
France	50	50	0	0
Germany	25	63	12	0
Greece	3	97	0	0
Ireland	28	18	0	54
United Kingdom	55	8	7	30
United States	41	17	22	20

Looking on dates presented in table 2, we can say that after land filling, application to land represent the most used method of disposal for sewage sludge (except Austria, where incineration is preferred).

Sludge from sewage treatment plants before application to land, must be tested and the parameters which are monitored are the following: dry matter (%), organic matter (% dry solids), pH, total nitrogen N total (%), phosphorus total (%), copper (mg / kg dry solids), nickel

(mg / kg dry solids), zinc (mg / kg dry solids), cadmium (mg / kg dry solids), lead (mg / kg dry solids), mercury (mg / kg dry solids), chromium (mg / kg dry solids).

To these parameters, the UK Department of the Environment, in 1989 has added molybdenum, selenium, arsenic, and fluoride. Sludge must be analyzed at least once every six months and every time significant changes occur in the quality of sewage treated.

RESULTS AND DISCUSSION

There is no general agreement concerning the maximum allowable concentration of various metals in sewage sludge.

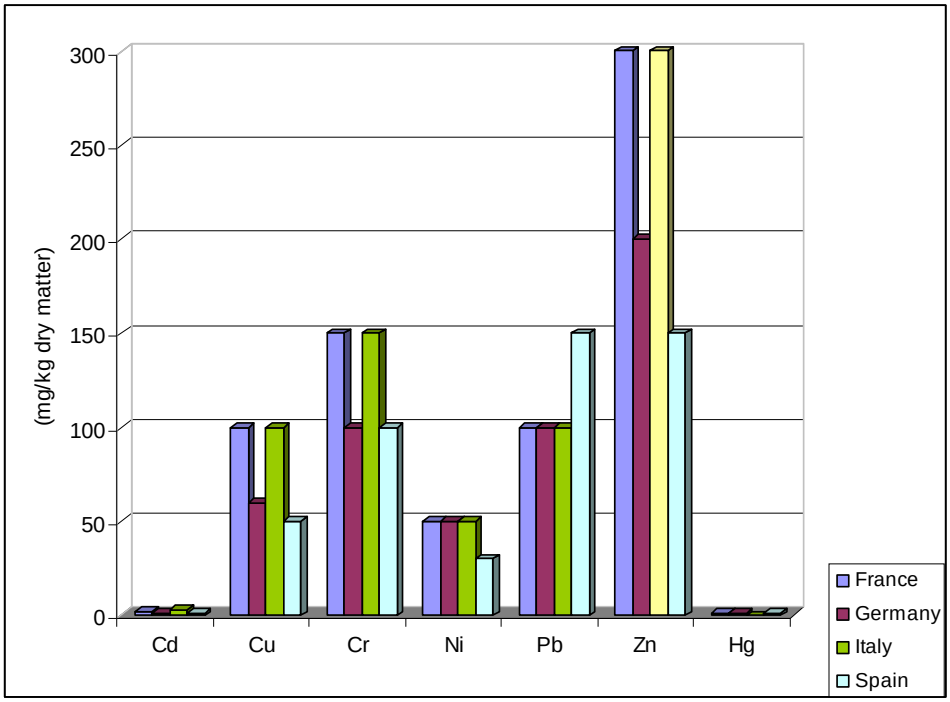

Fig.1 Maximum allowable concentrations of some metals in sewage sludge in some countries.

In Table 3 are presented physical and chemical features of sewage sludge from Timisoara.

The application of sewage sludge on agricultural fields had the advantage of being the less expensive method of neutralisation and recycling of these kinds of organic residues.

Unlike developed country where a large amount of sewage sludge that results from residual water cleaning is applied in agriculture, in our country these residues are disposed uncontrolled and bring out soil and phreatic waters pollution.

Table 3

Physical and chemical features of sewage sludge from Timisoara

Parameter	Measure unity	Value	Maximum admissible value
Humidity	%	49.36	
Organic matter	%	36.32	
pH		5.80	
N total	%	0.97	
P total	%	0.58	
K total	%	1.42	
Na	%	0.15	
Ca	%	0.35	
Mg	%	0.30	
Cu	(mg/kg)	509.6	500
Zn	(mg/kg)	619	2000
Mn	(mg/kg)	214	500
Pb	(mg/kg)	261	300
Cd	(mg/kg)	23.5	10
Co	(mg/kg)	25.5	50
Ni	(mg/kg)	70	100
Cr	(mg/kg)	982.5	500

Because of chemical composition, the use of sewage sludge in agriculture represents a neutralisation method by soils. However, the soil possibilities of taking over complex organic substances and heavy metal cations depend on soil type and climacteric conditions.

To avoid some unpleasant effects of sewage sludge application, we must keep account of physical, chemical, and biological features, soil features and plants capacities of nutritive elements valorisation and environment pollution danger.

The concentration of potentially toxic elements in arable soil must not exceed certain prudent limits within the normal depth of cultivation because of sludge application.

In Table 4 are given the maximum permissible concentrations of the potentially toxic elements in soil, after sewage sludge application (according to the UK Code of Practice)

For Zn, Cu and Ni, the maximum permissible concentration vary with the pH of the soil because it is known that crop damage from phytotoxic elements is more likely to occur on acid soils.

CONCLUSIONS

The use of sewage sludge in agriculture represents one of the most practical ways in sewage sludge removal.

1. Because of its chemical features, sewage sludge represents alternative fertilizing resources.
2. To avoid some unpleasant effects of sewage sludge application in agriculture, we must know its chemical features, soil physical and chemical properties, and climacteric conditions.

3. This practice present some advantages:

Table 4

Maximum permissible concentration of potentially toxic elements in soil after application of sewage sludge (Source: Department of Environment)

Potentially toxic element (PTE)	Maximum permissible concentration of PTE in soil (mg/kg dry solids)			
	pH = 5.0 – 5.5	pH=5.5 – 6	pH= 6.0 – 7.0	pH≥ 7
Zn	200	250	300	450
Cu	80	100	135	200
Ni	50	60	75	110
Cd	3			
Pb	300			
Hg	1			
Cr	400			
Mo	4			
Se	3			
As	50			
Fluoride	500			

- valorisation of some important amounts of nutrients for plants (humus, nitrogen, phosphorus, potassium, trace elements);
- diminishing amounts of inorganic fertilizers which are necessary to maintain the soil fertility;
- utilization the soil capacity of mineralization;
- concentration of potential toxic elements from soil, after sewage sludge application must not exceed the maximum permissible values, on arable stratum. Sewage sludge must not be applied of any soil where concentration of these parameters exceeds limits.

LITERATURE

1. RENNER, R., – *Sewage Sludge, Pros & Cons*, Environmental Science & Technology V.34 – I.19, 1 oct. 2000
2. KELLEY, W.D., MARTENS, D.C., RENEAU, R.B., SIMPSON, T.W., – *Agriculture use of Sewage Sludge*, Department of Agronomy, Virginia Polytechnic Institute and State University, Bulletin 143 , USA, pp.1-26, 1984
3. RÖHRS, L.H., FOURIE, A.B., BLIGHT, G.E., – *Effect of sewage sludgeand refuse composition on the rate of degradation and leachate quality of co-disposed waste in a water defficient environment* , pp 137-146, Water SA, vol. 24, South Africa, 1999
4. ARCAK, S.,KARAKA, A., HAKTANIR, K., – *Investigation of sewage sludge: chemical composition and effects on some chemical properties of soil*-, Soil Science Department, Faculty of Agriculture Ankara, Turkey, 2003
5. PASCUAL, I., ANTOLIN, M., GARCIA, C., POLO, A., *Plant availability of heavy metals in soil amended with a high dose of sewage sludge under drought conditions*, Biology and Fertility of Soils, vol.40, nr.5, pp:291-299, 2004

6. LEONARD, I., *Riscul de translocare a metalelor grele provenite din namolul de epurare orasenesc, din sol in planta*, Revista de Politica Stiintei si Scientometrie, Numar special, Bucuresti, 2005
7. xxx, *Planul National de gestionare a deseurilor*, Ministerul Mediului si Gospodaririi apelor, Bucuresti, 2004
8. xxx, *Mediul inconjutor in Romania*, Institutul National de Statistica, Bucuresti 2001.